

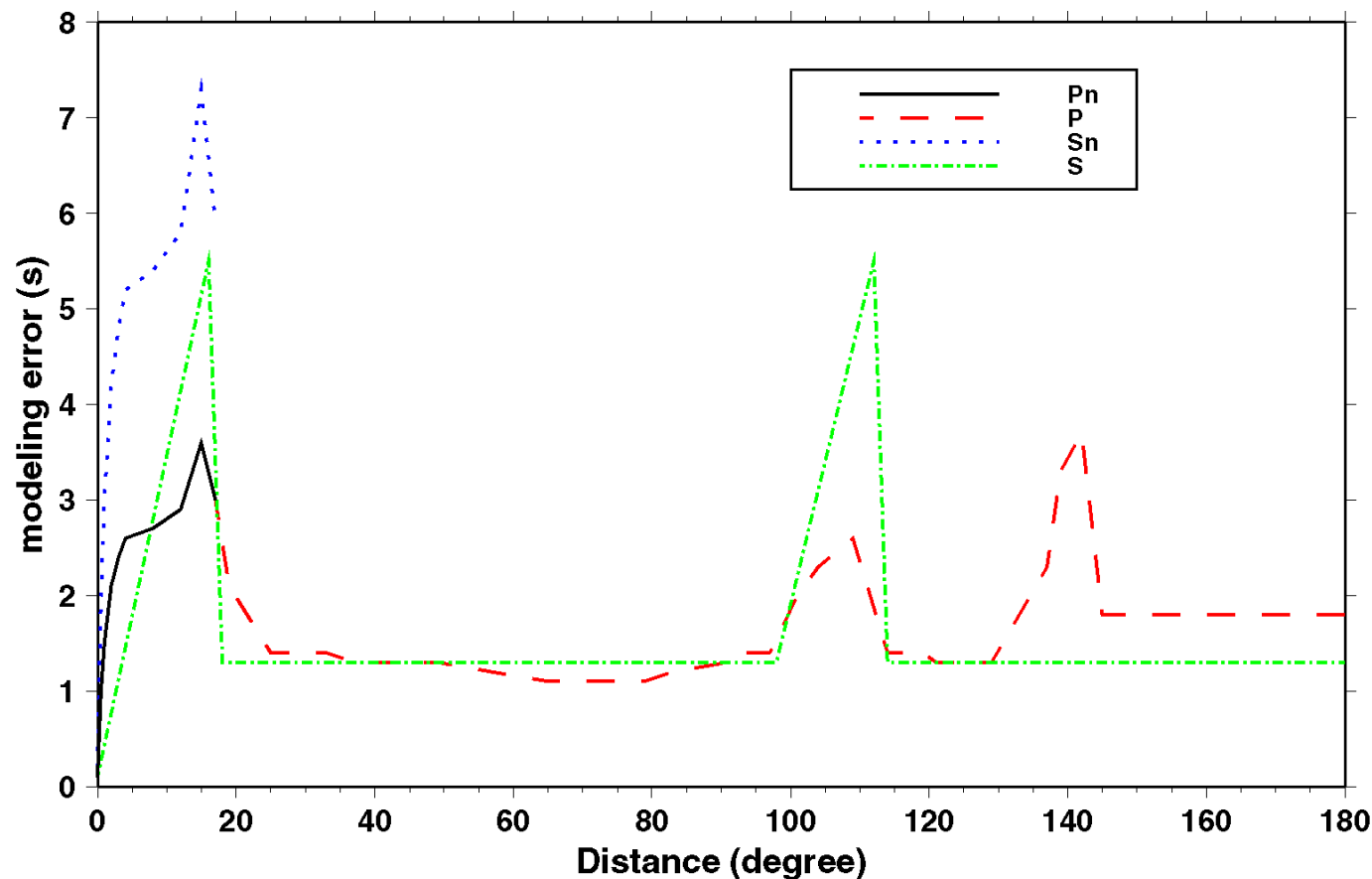
# **A New GT Origin Database and Benchmark Location Results – A Test of the Error Model**

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- **IDC *a-priori* model errors**
- **Definition of coverage statistic, E**
- **GT0-GT10 event test set**
- **Test of IDC error model**
- **Conclusions**
- **Discussions**

# IDC *a-priori* model errors

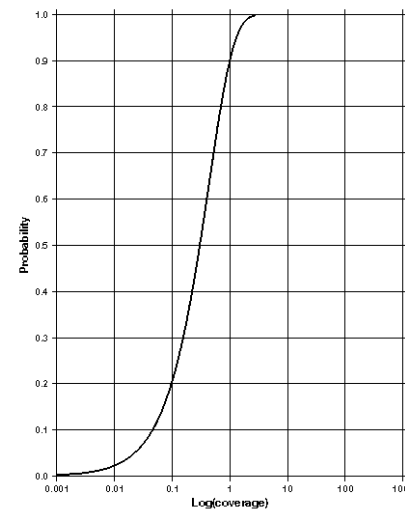
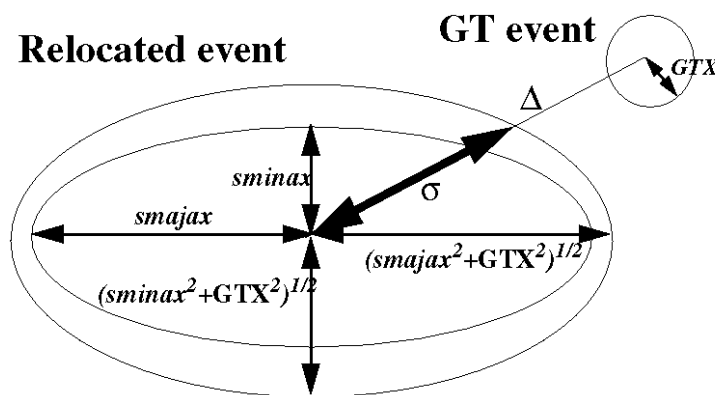


- *A-priori* errors predict 90% error ellipses
- *A-priori* total errors weigh arrivals in event location

# Coverage statistic, E

- Coverage statistic:

$$E = \frac{x^2}{s_{majax}^2 + GTX^2} + \frac{y^2}{s_{minax}^2 + GTX^2}$$



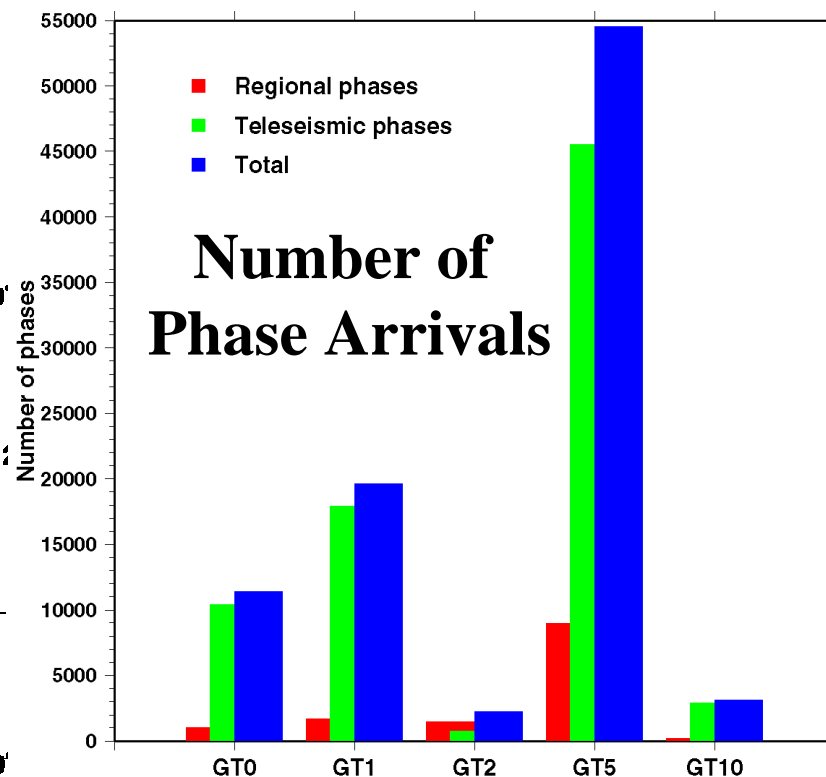
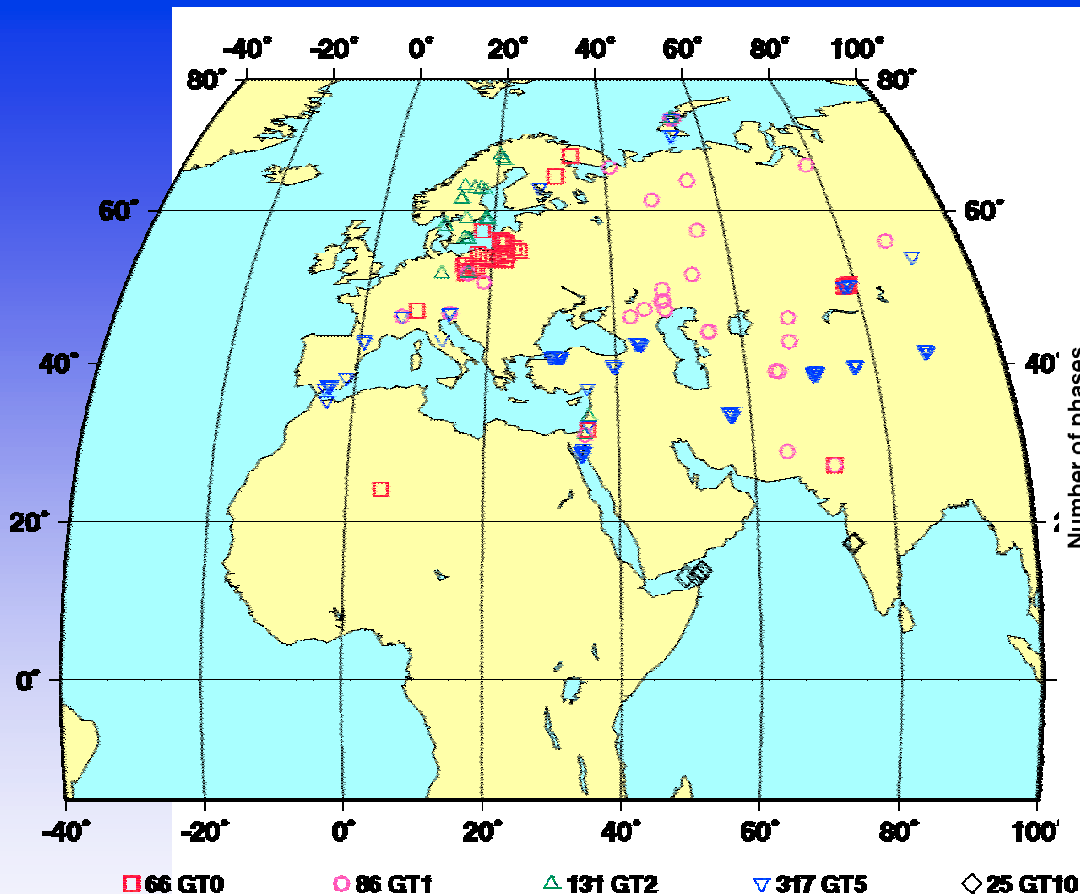
**Expected values:**

**E = 1.0 @ 90%**

**E = 0.3 @ 50%**

**E should be  $\chi^2$  with 2 dof**

# GT0-GT10 event test set



~ 600 GT0-GT10 events (>3 Pn, Sn phases)  
 ~ 10,000 Pn & Sn at ~1,500 stations  
 ~ 77,000 teleseismic P & S

- **Data set is by-product of the Group-2 testing**
  - **GT0-GT10 events collected to test and validate 3D models**
  - **An opportunity to test existing IDC error model with large set of GT0-GT10 events.**
  - **Regional & teleseismic arrivals**
  - **P & S arrivals**
  - **Over 600 events (>3 Pn, Sn phases) relocated using IDC IASPEI91 travel-times & model error**

# Coverage statistic, E

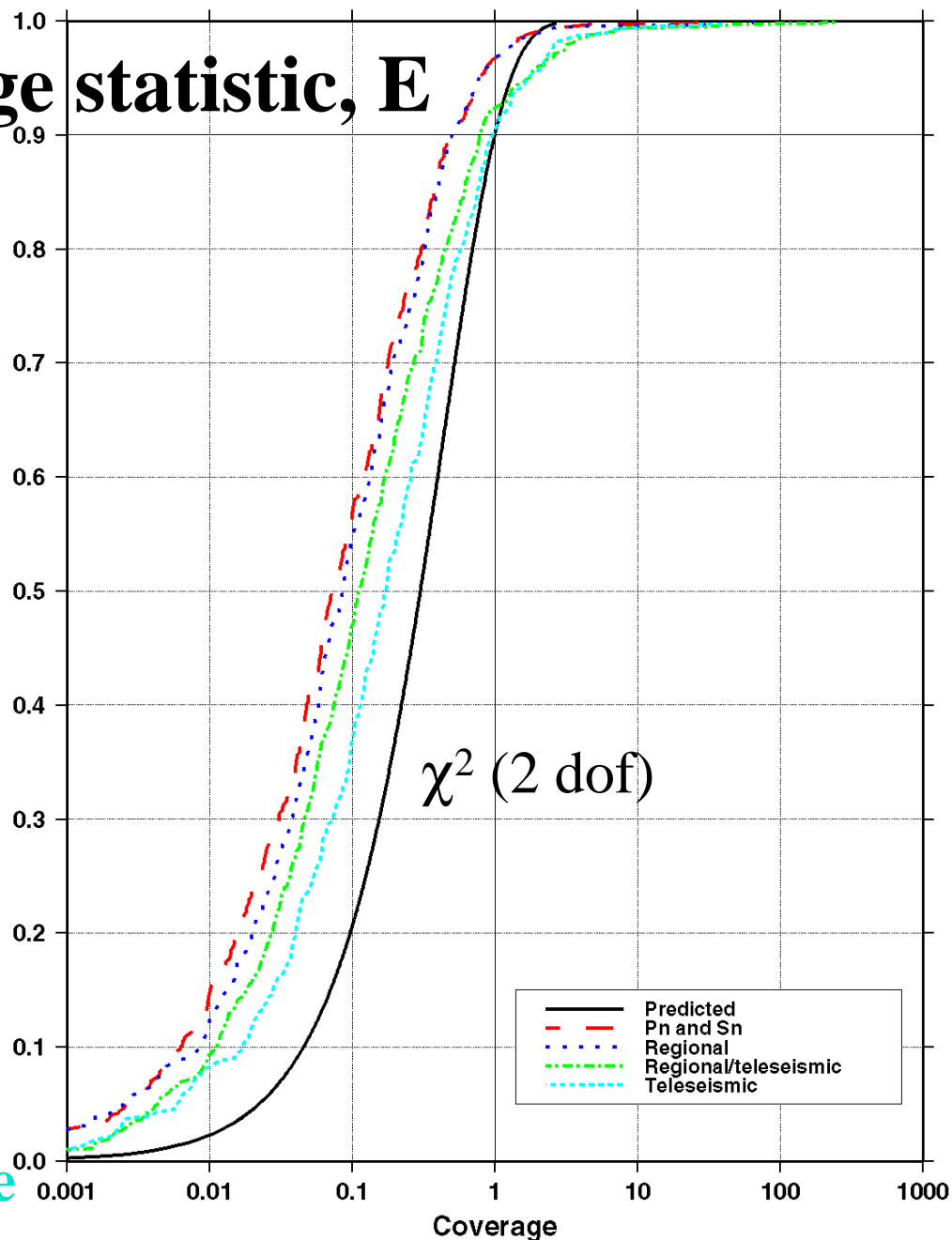
- 90% coverage ( $E=1$ ) met/exceeded in all cases
- With large # events sampling error ~1-2%
- Median values consistently better than expected
- 95-98% values worse than expected

test	# of events	90% coverage
Pn and Sn phases	571	97%
all regional phases	575	97%
all regional and teleseismic phases	625	93%
all teleseismic phases	375	91%

test	median	90%	95%	98%
predicted value	0.3	1.0	1.3	1.7
Pn and Sn phases	0.1	0.5	0.8	1.2
all regional phases	0.1	0.5	0.8	1.4
all regional and teleseismic phases	0.1	0.8	1.7	3.2
all teleseismic phases	0.2	1.0	1.7	2.6

# Coverage statistic, E

- **Pn & Sn: better than predicted nearly all of the time- errors too conservative.**
- **Regionals only: errors too conservative.**
- **Regional+teleseismic: better than predicted most of the time- too many outliers 5-7% of the time.**
- **Teleseismic only: too many outliers 7-8% of the time; underestimated for confidence levels > 92%.**





# Conclusions (1)

- Coverage performance evaluated using large set of GT0-GT10 events:
  - The current IDC *a-priori* modeling error estimates are reasonable and "honest" at 90% confidence level.
  - Tests validated the existing combined and separate regional and teleseismic model errors w.r.t. honest 90% ellipses.
  - The relative errors of regionals and teleseismics appear correct.
  - Compared to theoretical  $\chi^2$  distribution, outliers exceed expected number at a high significance level.
  - Underlying "Gaussian statistics" for model and measurement errors probably inadequate for data set.

## Conclusions (2)

- **Current modeling errors appear to be conservative compromise:**
  - **90% error ellipses are "honest".**
  - **However, to predict "honest" 95% or 98% error ellipses, the errors need to be inflated.**
  - **Given the error model, 50%-60% of the time the locations are better than should be expected.**
  - **< 10% of the time locations are worse than should be expected.**

- **Account for GT accuracy when evaluating calibration and error models...**
- **5-10% events will continue to be a persistent problem...**
- **A new underlying error methodology is needed to account for:**
  - **Non-Gaussian errors...**
  - **Bad picks...**
  - **Misassociations...**
- **Location calibration without quality GT origins/arrivals?**
- **Resource allocated for reference event collection?**